Industrial Artificial Intelligence in Industry 4.0 - Systematic Review, Challenges and Outlook

Year: 2020 | Citations: 358 | Authors: Ricardo Silva Peres, Xiaodong Jia, J. Lee, K. Sun, A. Colombo

Abstract

The advent of the Industry 4.0 initiative has made it so that manufacturing environments are becoming more and more dynamic, connected but also inherently more complex, with additional inter-dependencies, uncertainties and large volumes of data being generated. Recent advances in Industrial Artificial Intelligence have showcased the potential of this technology to assist manufacturers in tackling the challenges associated with this digital transformation of Cyber-Physical Systems, through its data-driven predictive analytics and capacity to assist decision-making in highly complex, non-linear and often multistage environments. However, the industrial adoption of such solutions is still relatively low beyond the experimental pilot stage, as real environments provide unique and difficult challenges for which organizations are still unprepared. The aim of this paper is thus two-fold. First, a systematic review of current Industrial Artificial Intelligence literature is presented, focusing on its application in real manufacturing environments to identify the main enabling technologies and core design principles. Then, a set of key challenges and opportunities to be addressed by future research efforts are formulated along with a conceptual framework to bridge the gap between research in this field and the manufacturing industry, with the goal of promoting industrial adoption through a successful transition towards a digitized and data-driven company-wide culture. This paper is among the first to provide a clear definition and holistic view of Industrial Artificial Intelligence in the Industry 4.0 landscape, identifying and analysing its fundamental building blocks and ongoing trends. Its findings are expected to assist and empower researchers and manufacturers alike to better understand the requirements and steps necessary for a successful transition into Industry 4.0 supported by AI, as well as the challenges that may arise during this process.